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The species biodiversity at different stations of Vembanad backwaters, Alappuzha district, Kerala, India

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Abstract
The Present investigation was carried out for biodiversity at selected centres on either sides of Thanneermukkom bund, Alappuzha district, Kerala. Observations were made from selected centres for a period from September, 2015 to July, 2016, covering the four meteorological seasons: post-monsoon, northeast monsoon, pre-monsoon and south-west monsoon. The observations were carried out from four stations, among that first two stations were selected to the northern side of Thanneermukkom bund and the other two stations were selected to the southern side of the bund. Most of the stations were covered with the aquatic plants especially water hyacinth (*Eichhornia crassipes*). Total 44 fin fishes belonging to the 29 families, and Shell fishes like *Macrobrachium rosenbergii*, *Metapenaeus dobsoni* were collected during the study period. One species of crab *Scylla serrata* and black clam *Villorita cyprinoides* were also collected. 22 species of phytoplankton and 4 species of zooplanktons were identified during study period.

Keywords: Aquatic plants, biodiversity**,** fin fishes, phytoplankton, shell fishes, zooplankton.

Introduction
The Vembanad backwater ecosystem forms the largest water body in Kerala and the third largest in the country. The lake is a part of Vembanad-Kol wetland system which extends from Alappuzha in the south to Azhikkode in the north, making it by far, India's longest lake at just over 96.5 km in length. The lake is bordered by Alappuzha, Kottayam, and Ernakulam districts. It is situated at the sea level, and is separated from the Arabian Sea by a narrow barrier island Vembanad Kol wetland was included in the list of wetlands of international importance, as defined by the Ramsar Convention for the conservation and sustainable utilization of wetlands.

Kuttanad is a region in the Alappuzha, Pathanamthitta and Kottayam District, in the state of Kerala, India, well known for its picturesque vast paddy fields and its geographical peculiarities. It's the region with the lowest altitude in India, and one of the few places in the world where farming is carried out below sea level. It's also one of the historically important places in the ancient history of South India. The ecology of kuttanad is greatly influenced by the mixing of flood water and sea water entering to the Vembanad Lake. The famous rice bowl of Kerala has now become the poison bowl [1] mainly due to intensive agricultural practices, unscientific establishment of various developmental projects and the sheer lack of proper sanitary facilities and waste water management. The wide ranges of variations in salinity from pure water to sea water provide a favourable environment for rich aquatic life. Fisheries is one of the most important activities which involves about 2100 fishermen, either fulltime or part time.

Thanneermukkom salt water barrier constructed as a part of the Kuttanad Development Scheme to prevent tidal action and intrusion of salt water into the Kuttanad low- lands. It is the largest mud regulator in India and essentially divides the lake into two parts - one with perennial brackish water and the other with freshwater from rivers draining into the lake. This barrier has helped farmers in Kuttanad by freeing the area of salinity and allowing them an additional crop in the dry season. The Thanneermukkom barrier is located at one of the narrower parts of the Vembanad Lake. Only two-thirds of the original numbers of gates are opened in July to release flood flow.

These gates remain closed until mid- November. The main drawback of the structure has been the loss of opportunity for fish and prawns to migrate upstream, and also an increase in weed growth in the upstream, severely restricting the natural flushing of pollutants. The Thanneermukkom bund has also created ecological problems, primarily, the rampant propagation of the Water Hyacinth in fresh water. The physico chemical characteristics are greatly affected due to discharge of domestic, industrial effluents and several other factors during day in day out [2].

Described in detail that dams and barrages have negative impact not only on many endemic and migratory food fishes such as *Tor tor* but also several small species such as *Glyptothorax lonah*, *Nemacheilus dayi*, *Ompok pabda etc.*

The distribution of fish fauna in rivers of Kerala have been described by several authors [3, 4] and management strategies have also been emphasized [5]. To study the species composition of finfishes on either sides of bund during the period of study.

Materials and Methods

Description of study area

Estuaries are among the most productive ecosystems on earth and more than 50% of the world population lives alongside of the estuaries and coastlines. Cochin Backwaters is a coastal plain and topographically a low lying area. It is characterized by its long axis running parallel to the Arabian coast and is separated from the sea by barrier spits interrupted by tidal passes at Azhikkode and Cochin Harbour mouth. Cochin estuary can be divided into three different zones based on the salinity contents. The first zone is completely saline and its salinity always is more than riverine water salinity. In the second zone, which coincides with the tidal excursion length, salinity varies periodically between freshwater and brackish water salinity. The third zone is always fresh and its salinity is the same as riverine water salinity. The major feature of the second zone may be its importance for water consumption, e.g. drinking.

Thanneermukkom bund is the largest mud regulator in the country. Thanneermukkom salt water barrier was constructed as a part of the Kuttanad Development Scheme. The huge construction was built across the lake Vembanad and divides the lake into two parts– one with brackish water perennial and other half with fresh water. Regular tidal flow, estuarine circulation and other allied hydrographical parameters in the Cochin Estuary has been changed due to regular closure and opening of Thanneermukkom bund and entry of saline water in to the estuary. Thermohaline variability in the Cochin estuary primarily depends on the mixing of fresh water with waters downstream and sea water intrusion to the upstream [6]. Due to the closure of the Thanneermukkom bund during the pre-monsoon periods, which prevents the salt-water penetration, the upstream area of Thanneermukkom bund has become completely devoid of euryhaline and stenohaline marine species. Although the barrier has contributed to the improvement of the crop production in lower Kuttanad, it seems to have affected the environment and fisheries adversely.

Selection of sampling stations

A preliminary survey was conducted for selection of sampling stations in selected centres on either sides of Thanneermukkom bund, Alappuzha district, Kerala. For the present investigation four sampling stations were selected and their locations are:

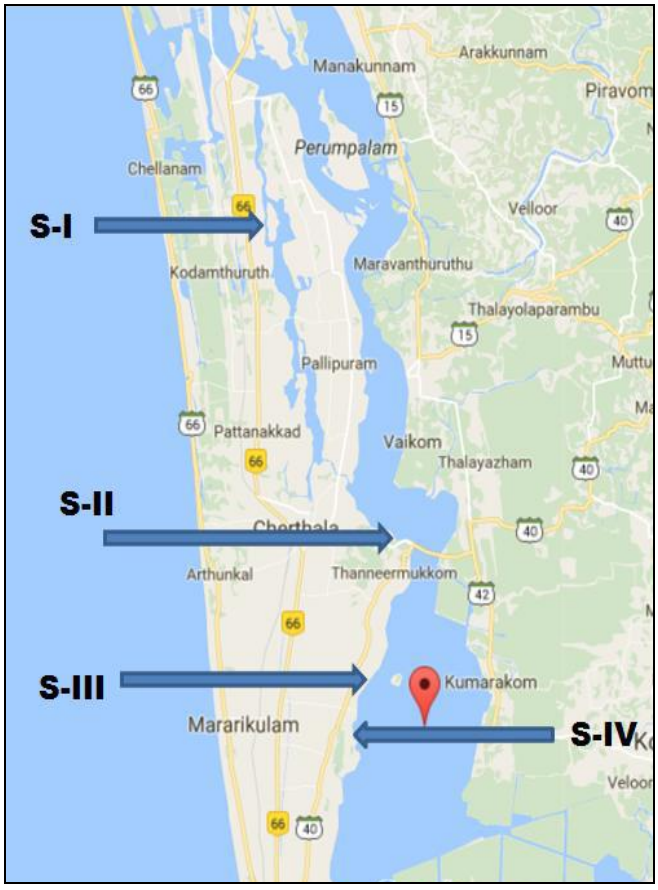

Plate 1: Sampling locations.

S-I: Eramallore, S-II: Thanneermukkom bund, S-III: Kayippuram, S-IV: Mohumma.

The first and second sampling stations brackish water regions located in northern side of Thanneermukkom bund and third and fourth stations fresh water regions located in southern side of Thanneermukkom bund.

Study period of sampling frequency

The study was conducted for a period of 11 months from September–2015 toJuly-2016. Meteorologically the whole study period can be classified as south -west monsoon (September 2015), post-monsoon (October 2015 to November 2015) and north-east monsoon (December 2015 to February 2016), pre-monsoon (March 2016 to May 2016) and south-west monsoon (June 2016 to July 2016). Monthly sampling was done for finfish and shellfish and zooplankton biodiversity of selected centres on either sides of Thanneermukkom bund.

Biological studies

Zooplankton analysis

The plankton samples were collected fortnightly for the qualitative and quantitative analysis at fixed time between 6:30 am to 9:30 am. The plankton samples were collected using bolting silk cloth (25 µ aperture) plankton net of 50 cm. diameter from the selected sampling stations following standard methods [7]. The collected plankton samples were preserved in 4% formalin for analysis in the laboratory [8]. The identification of zooplankton was carried out in the laboratory under compound microscope (10-40X) by using keys and monographs of standard references [8, 9].

Collection and identification of fish community

For the study of finfish and shellfish biodiversity samples were collected from all the four sampling stations by using cast nets (16 mm. and 22 mm.) and scoop net (4 mm.) during day time between 9:30 am and 4:30 pm. The collected samples were labelled and preserved in 10 % formalin. The varieties of fish caught from the selected centres on either sides of Thanneermukkom bund were identified to the genus level by referring [10, 11].

Results and Discussion

The biological characteristics of selected centres on either sides of Thanneermukkom bund were studied. The finfish and shell fish biodiversity and abundance of zooplankton during September 2015 to July 2016 were estimated from the four stations.

Biodiversity

Finfish diversity

The backwaters in Kerala form a habitat for over 200 resident and migratory fish and shellfish species and fishing activities in these water bodies provide the livelihood to about 2,00,000 fishers and provide full time employment to over 50,000 fishermen [12].

44 finfishes were identified belonging to the 29 families during study period September 2015 – July2016. (Table 1).

Table 1: Finfish species collected from selected centres on Thanneermukkom bund.

Sl. no	Species	Family	Habitat
1	*Ambassis ambassis*	Ambassidae	M F B
2	*Paraambassis dayi*	Ambassidae	F B
3	*Anabas testudineus*	Ambassidae	F B
4	*Anguilla bengalensis*	Anguillidae	M F B
5	*Horabagrus brachysoma*	Bagridae	F B
6	*Mystus oculatus*	Bagridae	F B
7	*Xenentodon cancila*	Belonidae	M F B
8	*Brachirus orientalis*	Bothidae	M B
9	*Chanos chanos*	Chanidae	M F B
10	*Etroplus maculates*	Cichilidae	F B
11	*Etroplus suratensis*	Cichilidae	B
12	*Oreochromis mossambicus*	Cichilidae	F B
13	*Cynoglossus cynoglossus*	Cynoglossidae	M B
14	*Cynoglossus microlepis*	Cynoglossidae	F
15	*Amblypharyngadon microlepis*	Cyprinidae	F
16	*Catla catla*	Cyprinidae	F B
17	*Labeo dussumeri*	Cyprinidae	F B
18	*Labeo rohita*	Cyprinidae	F B
19	*Puntius amphibious*	Cyprinidae	F B
20	*Puntius filamentosus*	Cyprinidae	F B
21	*Puntius sarana*	Cyprinidae	F B
22	*Anatondostoma chacunda*	Dorossomidae	M F B
23	*Nematalosa nasus*	Dorossomidae	M F B
24	*Eleotris fusca*	Eleotridae	M F B
25	*Stolephorus commersonnii*	Engraulidae	M B
26	*Stolephorus indicus*	Engraulidae	M B
27	*Thryssa malabarica*	Engraulidae	M B
28	*Glossogobius giurius*	Gobidae	M F B
29	*Gerres setifer*	Gerridae	M B
30	*Gerres filamentosus*	Gerridae	M F B
31	*Hyporhampus xanthopterus*	Hemirhamphidae	M F B
32	*Heteropneustus fossilis*	Heteropneustidae	F B
33	*Megalops cyprinoides*	Megalopidae	M F B
34	*Mugil cephalus*	Mugilidae	M F B
35	*Liza macrolepis*	Mugilidae	M F B
36	*Liza parsia*	Mugilidae	M F B
37	*Pristolepis fasciata*	Nandidae	F
38	*Channa marulius*	Ophiocephalidae	F
39	*Channa striata*	Ophiocephalidae	F B
40	*Eleutheronema tetradactylum*	Polynemidae	M F B
41	*Scatophagus argus*	Scatophagidae	M F B
42	*Sillago sihama*	Sillaginidae	M B
43	*Ompok bimaculatus*	Siluridae	F B
44	*Wallago attu*	Siluridae	F B

Note: F: Fresh water, B: Brackish water, M: Marine water.

Estuaries and brackish water impoundments form the nursery grounds for several economically important species of finfish and shellfish [13, 14]. The seasonal changes in hydrography play an important role in regulating the fauna of back water [15, 16]. Also observed the abundance of seed of *P. indicus* during pre-monsoon and late post-monsoon period in Mulki Estuary [17]. Prepared broad description of fishing practices in Vembanad Lake along with list out of the commercially important fish

and prawn species.
44 finfishes were collected from the study areas, belonging to the 29 families during study period.
Distribution and abundance of *Etroplus suratensis*, a cichlid endemic to peninsular India and Sri Lanka has been reported by several authors [18, 19], [20].
Listed 150 species of fishes belonging to 100 genera categorised under 56 families in Vembanad Lake [21]. Studied the impact of indiscriminate fishing practices and environmental stress on the Macrobrachium fishery of the Vembanad Lake and he also described the fishery and biology of four species of *Macrobrachium viz*., the *M. rosenbergii, M. idella, M. scabriculum, M. equidens*

Shell fish diversity
Various species of shellfishes were found in the study area.
a) Prawns included
Family: Palaemonidae.
Macrobrachium rosenbergii.
Family: Penaeidae
Metapenaeus dobsoni
b) Crabs include
Family: Portunidae.
Scylla serrata.

c) Clams include
Family: Cyrenidae.
Villorita cyprinoides.

Clam fishery is important resource of Vembanad Lake. Its fishery was studied by [22]. Prawns mainly *Macrobrachium rosenbergii*, *Metapenaeus dobsoni*, one species of crab (*Scylla serrata*) and black clam (*Villorita cyprinoides*) were identified during study period. The distribution and abundance of prawns and prawn larvae in Cochin backwaters were studied by [23, 24]. Reported that *P. indicus* were relatively more during pre-monsoon season in Cochin backwaters [16]. Reported the abundance of *P. monodon* seed during pre-monsoon season in the Mulki Estuary.

Phytoplankton Biodiversity
During present study period following 22 species Phytoplankton were identified at all stations (Plate: 2).

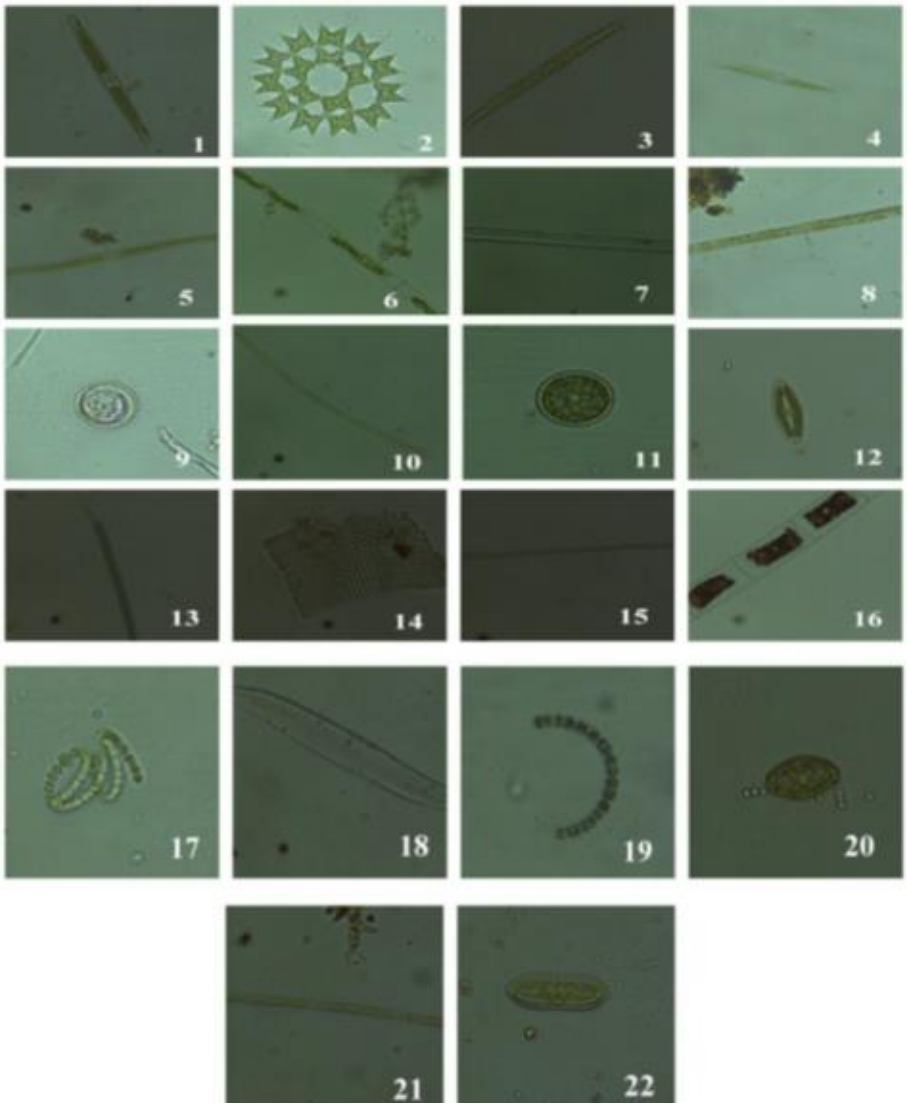

Plate 2: Phytoplankton species. 1. *Closterium*, 2. *Pediastrum duplex*, 3. *Closterium moniliferum*, 4. *Nizschia*, 5. *Nizschia Spathulata*, 6. *Scalariaform undulispta*, 7. *Ditatoma vulguare*, 8. *Synedra ulna*, 9. *Cyclotella Striate*, 10. *Datyliselen sp*, 11. *Cosinodiscus*, 12. *Navicula sp*, 13. *Oscillatoria phormidium*, 14. *Alulacoseraia Sp*, 15. *Lynbaya*, 16. *Spirogyra*, 17. *Diploneis robustus*, 18. *Gyrosima*, 19. *Entomoauis*, 20. *Dinobryan Steralaria*, 21. *Diploneis Smithii*, 22. *Anabaena* [25].

Studied about the phytoplankton in the Cochin backwaters and reported the presence of 62 species of Bacillariophyceae, 24 species of Dinophyceae, 3 species of Myxophyceae and 2 species of Cilioflagellates.

Species composition and seasonal variation in phytoplankton abundance has been studied in other regions of Indian coastal waters [26, 27], 28].

Studied and reported rainfall, river discharge and decreased phytoplankton and increased turbidity. These important factors are control the distribution of copepods.

Zooplankton Biodiversity

Zooplanktons are tropic planktonic animals floating in water. They serve as good indicators of changes in water quality. During present study period following the 4 Zooplanktons were identified at all stations (Plate: 3).

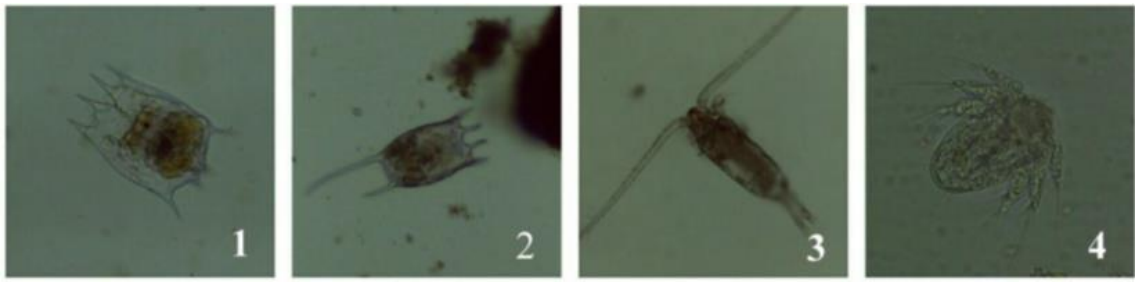

Plate 3: Zooplankton species 1. *Brachionus caudacious*, 2. *Rotifer*, 3. *Copepoda, (Harpaticoid)*, 4. *Copepod nauplii.*

The collection of zooplankton was done in early morning because most of the zooplankton's shows diurnal vertical migration, zooplanktons collected by filtering 50 L of water through plankton net of mesh sizes 25µ uniformly from the all the stations and preserved in 5% of formalin as concentrate in 250 ml bottle for further Identification [29].

Opined that Zooplankton provides an important food source for larval fish and shrimp in natural waters and in aquaculture ponds. Fishery was attributed to the reduced zooplankton especially copepod population.

Zooplankton plays a major role in the functioning and the productivity of aquatic ecosystems [30]. Many species of zooplankton can be used as biological indicators for water pollution, water quality and eutrophication [31, 32]. Reported that copepods were very important in assessing the health of coastal ecosystems [33]. Observed higher values of zooplankton density and species diversity during pre-monsoon and summer seasons in Kaduviyar estuary.

Aquatic plants

The present study was undertaken to understand the biodiversity of aquatic plants of selected centres on either sides of Thanneermukkom bund. Following four aquatic plants were identified during study period. (Plate: 4).

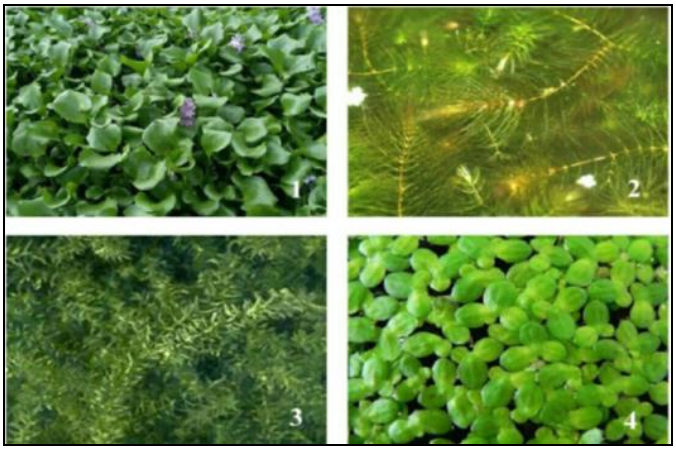

Plate 4: Aquatic plants

1. Water hyacinth (*Eichhornia crassipes*)
2. Ceratophyllum (*Ceratophyllum demersum)*
3. Hydrilla (*Hydrilla verticillata)*
4. Duck weed *(Lemna minor)*

Most of the stations were covered with the aquatic plants especially water hyacinth (*Eichhornia crassipes*) Ceratophyllum (*Ceratophyllum demersum)*, Hydrilla (*Hydrilla verticillata)*, duck weed *(Lemna minor)*. Water hyacinth was occupying large area at station (1) and (2). At the station (3) and (4) the growth was comparatively less.

Conclusion

The Vembanad backwater supports diverse fish and shellfish fauna worth for rural livelihood through capture, culture, or sports fishery. The findings of present study may serve as baseline information for planning, conservation and management of fisheries resources of Vembanad backwater in the future.

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